DOCUMENT RESUME

ED 233 140 CE 036 553

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TITLE Competency Based Instructional Resource Guide. Sample Format. Welding.
INSTITUTION Virginia Polytechnic Inst. and State Univ., Blacksburg. Div. of Vocational-Technical Education.
SPONS AGENCY Virginia State Dept. of Education, Richmond. Div. of Vocational Education.
PUB DATE 80
GRANT VA-80-C-131-3-AD-001
NOTE 58p.; Parts of this document may not reproduce well. For a related document, see CE 036 554.
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Articulation (Education); Classroom Techniques; Competence; *Competency Based Education; *Course Content; *Curriculum Development; *Instructional Materials; *Material Development; Models; Occupational Information; Program Implementation; Recordkeeping; Secondary Education; State Curriculum Guides; Task Analysis; Teaching Methods; Welding
IDENTIFIERS *Virginia

ABSTRACT

The purpose of this sample guide is to assist teachers and curriculum specialists in developing instructional materials that are competency based and that meet Virginia standards for competency-based education (CBE) programs. The sample deals with the occupation of welding, but it is the format that is of interest here, not the subject matter. Following introductory information on how to use the guide and how to develop and implement a CBE, the guide is organized into six sections. The first section contains information concerning the occupation for which the curriculum materials are being written; this information is useful for preparing instructional activities and for counseling students. In the second section, the process of task analysis is shown, based on the results of a validated task inventory. This section contains a list of actual task/competency statements for workers, occupational titles, codes for the Dictionary of Occupational Titles, program and course titles, performance and enabling objectives, criterion-referenced measures, tools, materials, supplies, audiovisual materials, and references related to the task. The third section describes the approved programs and courses offered for the occupational area, correlated with the task analyses. The fourth and fifth sections contain sample classroom management systems and student recordkeeping systems that have been field tested and are designed for welding courses. Additional resources, books, periodicals, films, tapes, instructional materials, and trade associations are listed in the final section of the guide. (KC)

ED233140

SAMPLE FORMAT

for

COMPETENCY BASED INSTRUCTIONAL RESOURCE GUIDE

James L. Hoerner
Ralph A. Horne

VIRGINIA TECH

This sample format was developed for the Virginia Department of Education, Division of Vocational and Adult Education under the provisions of the Articulation and CBE Coordination Project Grant #VA-80-C-131-3-AD-001 awarded to Virginia Tech, Blacksburg, VA.

1980

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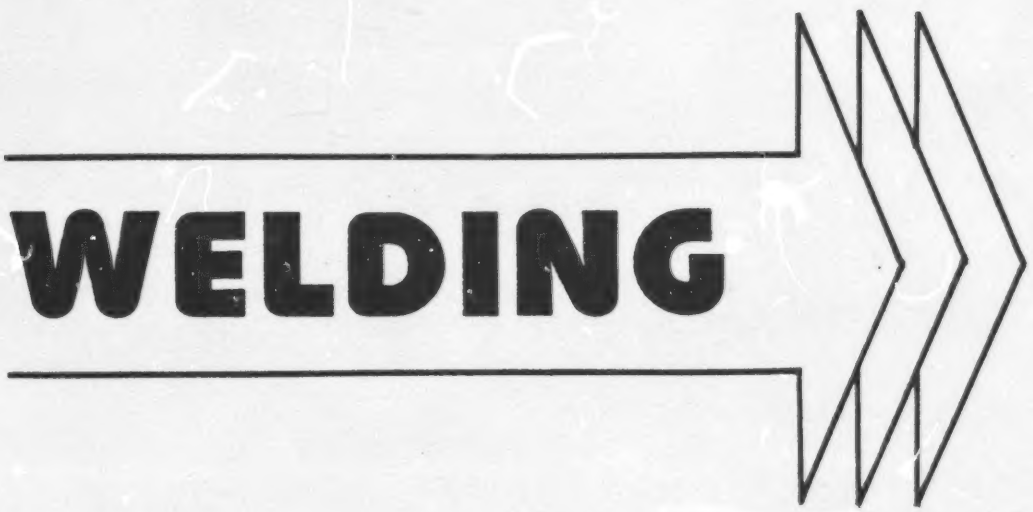

WELDING

DIVISION OF PROGRAM SERVICES
VOCATIONAL EDUCATION
DEPARTMENT OF EDUCATION
COMMONWEALTH OF VIRGINIA
RICHMOND, VIRGINIA 23216

JUNE 1980

COMPETENCY BASED INSTRUCTIONAL RESOURCE GUIDE for WELDING

PROJECT DIRECTOR

Name of Project Director

This instructional resource guide was developed for the Virginia Department of Education, Division of Vocational and Adult Education under the provisions of an Articulation and CBE Project Grant #80-C-131-3-AD-001 awarded to the educational institutions in the Southwest Virginia Community College Region.

1980

FOREWORD

In the next decade, large numbers of welders will be required in Virginia's businesses and industries. Vocational and technical education at the secondary and post-secondary levels will be responsible for preparing the individuals for this occupational area.

Through competency based vocational education, students will be prepared to assume their roles in Virginia's work force. Articulation and re-education of workers in our vocational and technical programs will be enhanced by competency based education.

This guide has been prepared to assist teachers and administrators in developing instructional materials which meet the needs of the student and industry.

Melvin H. Garner
Administrative Director
Vocational and Adult Education

ACKNOWLEDGEMENTS

The development and completion of this guide required a vast expenditure of time, effort and teamwork among the project staff and participants. The teachers who served as researchers and writing team members for the guide are most deserving of recognition for their dedication, time and expertise:

Names of Teachers Who Served as Writers

Appreciation is also expressed to Harold Van Hook, Project Director, and his staff for their assistance and efforts in reviewing and editing the guide. Jacob H. Lowe and Foster Miles, Virginia Department of Education, are recognized for finalizing the guide for publication.

Finally, recognition and gratitude is given to James L. Hoerner and Ralph Horne, Project Directors for the coordination of the Articulation and CBE Projects. The contribution of these two individuals assisted in making the project a reality. Working with the state staff and project directors, they devoted many hours to the planning, organization and coordination of the instructional guide and other project goals.

Dewey T. Oakley, Jr.
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Dear Educator:

The enclosed sample format of the Competency Based Instructional Resource Guide was developed by the Articulation and CBE Coordination Project at Virginia Tech. The format is intended to serve as a state model for Virginia's effort in implementing competency based vocational education and articulating secondary and community college programs. During the next two years, guides will be developed for many of the vocational programs offered at the secondary and community college levels in Virginia. In addition, special formats will be developed for industrial arts and other specialized program areas.

The guide is designed primarily to serve as a resource for vocational teachers in developing instructional materials for competency based vocational courses and programs. It is not intended that the guide be used as a teaching tool in the classroom or used directly by students.

The guide is still under development and review; therefore, the format and content may be revised before final distribution to vocational educators. The technical content for the welding occupational domain is only an example for formatting purposes and should not be accepted as complete or valid. Only one task/competency was selected for task detailing (pages 21-22); the final guides may include 100-200 tasks/competencies. The completed guides will be loose-leaf to allow for revision and updating.

The following project directors, state department staff and program state supervisors of the various vocational services were instrumental in reviewing and suggesting improvements during the development of this sample format:

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INTRODUCTION

The development of this instructional resource guide and the implementation of competency based education (CBE) programs result partly from the 1978-79 Virginia State Plan for Vocational Education. The plan included an improvement objective:

> By June 30, 1982, each school division shall have implemented competency based instruction in approved vocational education programs based on V-TECS and IDECC catalogues if available or other competency-based materials as reported in the annual Local Evaluation Programs, and each community college shall have implemented competency based instruction in at least one program based on V-TECS materials as reported by the Virginia Community College System.

In addition to this objective in the state plan and previous efforts by state educators to implement CBE, Virginia has adopted the following standards for CBE programs:

I. ROLE-RELEVANT COMPETENCIES THAT INCLUDE STANDARDS ARE IDENTIFIED AND STATED.

The competencies with standards will be identified through V-TECS, IDECC, and other appropriate research. Advisory committees should be used to review competencies and standards. Competencies in the affective domain will be included. Role-relevant competencies for occupational preparation programs are those that specifically relate to the occupation for which the student is being prepared as well as to the personal needs of the student. Role-relevant competencies are related also to orientation, exploration and/or industrial arts experiences which have been identified for students.

II. COMPETENCIES ARE SPECIFIED TO STUDENTS PRIOR TO INSTRUCTION.

A system exists to inform students regarding what will be expected at program completion. For example, teachers may provide profiles, checksheets, training plans, contracts, or other structured methods to identify outcomes. Students are aware of expected outcomes.

III. CRITERION-REFERENCED MEASURES ARE USED TO MEASURE ACHIEVEMENT OF COMPETENCIES.

Criterion-referenced measures are based on standards that are measurable. Student performance is measured against predetermined standards rather than against other student's accomplishments.

IV. A SYSTEM EXISTS FOR DOCUMENTING THE COMPETENCIES ACHIEVED BY EACH STUDENT.

The documentation provides a record of competencies achieved. The documentation may be used for articulation of the program to provide a smooth transition of the student from one school to another or from one level of instruction to another level. The documentation is also a means for providing information to employers.

Therefore the purpose of this guide is to assist the teacher and curriculum specialist in developing instructional materials which are competency based and meet state standards for CBE programs. The guide may also be used to update CBE programs currently being offered. The content in the guide represents the efforts of many individuals and contains the latest occupational information available.

USER INFORMATION

This resource guide is divided into the following sections which contain useful information for preparing CBE instructional materials:

I. OCCUPATIONAL INFORMATION

Specific information concerning the occupation--nature of the work; place of employment; training and qualifications; employment outlook, working conditions; and salary--are provided in this section. The information is useful for preparing instruction activities and for counseling students.

II. TASK ANALYSIS

The course and program content is based on the results of the validated task inventory. This section contains a listing of actual task/competency statements for incumbent workers. Also included are applicable occupational titles, DOT codes, program and course titles, performance and enabling objectives, criterion-referenced measures, tools, materials, supplies, audio-visual materials and references related to the task. The task list is arranged by worker duty area only. No attempt has been made to sequence the tasks in this section of the guide.

III. PROGRAMS AND COURSES

This section describes the approved programs and courses offered for the occupational area. Program and course descriptions are linked to specific or closely related DOT job titles. Individual course outlines and task sequences are provided which are cross referenced by code number with the task analysis sheets in SECTION II.

IV. CLASSROOM MANAGEMENT SYSTEMS

Several sample classroom management and delivery systems have been included in this section. The systems have been field tested and are designed for welding courses. They are intended to assist the teacher in implementing CBE in the classroom and shop.

V. STUDENT RECORDING SYSTEMS

Record-keeping systems have been developed to assist the teacher and student in documenting successful achievement of competencies. This section contains sample classroom, permanent record, and student/employer recording systems.

VI. INFORMATION AND RESOURCES

Additional resources, books, periodicals, films, tapes, instructional materials and trade associations are listed. These materials are useful in supplementing and assisting the teacher in developing instructional materials and activities.

Coding System

The instructional guide has been designed to facilitate cross referencing between the task analysis information and course content outlines. This has been achieved by coding corresponding tasks, performance/enabling objectives and criterion-referenced measures with appropriate instructional content.

The system utilizes an alphanumeric code to identify specific task analysis information. The following chart illustrates the coding for duty area five (5) of an occupation:

INFORMATION	CODE
Duty Area	5.
Task/Competency	5.1
Performance Objective	P 5.1
Enabling Objectives #2	E 5.1.2.
Criterion Referenced Measure	C 5.1

Therefore, the coding system will assist instructors in identifying appropriate objectives and instructional materials for the course content outlines provided in SECTION III of this guide.

Definitions

The following definitions are used in this guide:

ARTICULATION: A planned process within an educational system that coordinates instructional programs which will enable students to move from one instructional level to another, or from one institution to another at the same instructional level, without unnecessary duplication or gaps in the instructional program.

CHECKLIST: A list of activities or behaviors that are checked by a student, teacher or observer as being done during a particular observation session; frequently used to assess student performance in the psychomotor and affective domains of learning.

COMPETENCY: Demonstrated ability (including knowledges, skills, or attitudes) to perform a specific task successfully to meet a specified standard.

COMPETENCY-BASED EDUCATION (CBE): Educational programs in which required performance is specified and agreed to in vigorous detail in advance of instruction. Standards for CBE in Virginia are as follows: (1) role-relevant competencies that include standards that are identified and stated; (2) competencies are specified to students prior to instruction; (3) criterion-referenced measures are used to measure achievement of competencies; and (4) a system exists for documenting the competencies achieved by each student.

COURSE: A defined segment of a program which includes a specified number of credit hours.

COURSE OUTLINE: A topical listing of the content of a specific course.

CRITERION (Criteria): The minimum standard that a student must meet to reach mastery of an objective.

CRITERION-REFERENCED TEST (CRT): A test constructed to yield measurements that are directly interpretable in terms of specified performance standards. An individual's performance is compared to a criterion, the criterion being the work or performance standard. Thus, the score on a CRT is based on absolute standards, such as job competency, rather than relative standards, such as class standing. (Also called a criterion-referenced measure, criterion-referenced evaluation, objective-referenced test, proficiency test, or a domain-referenced test.)

CURRICULUM: All the objectives, content, and learning activities arranged in a learning sequence for a particular instructional area. An orderly arrangement of integrated subjects, activities, and experiences which students pursue for the attainment of a specific educational goal.

DUTY: A distinct grouping of tasks which are related to each other by the nature of the work to be performed (i.e., Job-Duty-Task-Step).

ENABLING OBJECTIVE: An objective that identifies one thing a learner must be able to know or to do to perform the performance objectives.

ENTRY-LEVEL SKILLS: The set of competencies required of a beginning worker in an occupation for immediate productivity upon entering that occupation.

JOB: The composite of duties and tasks performed regularly in one's trade, occupation, or profession (i.e., Job-Duty-Task-Step).

INSTRUCTIONAL ACTIVITIES: Educational activities completed by the students to learn specific competencies. (Also called learning strategies.)

INSTRUCTIONAL RESOURCE GUIDE: A document that includes detailed information for developing competency based courses and programs. The guide includes information concerning the occupational domain, task list, performance and enabling objectives, criterion-referenced measures, learning activities, tools/materials, references, program and course descriptions, course content outlines, classroom management systems, student recording systems and additional resources.

OBJECTIVE: An intent communicated by a statement describing a proposed change in a learner--a statement of what the learner is to be like when he or she has successfully completed a learning experience. It is a description of a pattern of behavior (performance) we want the learner to be able to demonstrate.

OCCUPATIONAL DOMAIN: A group or listing of occupations within a vocational area that share common experiences, knowledge, and skill requirements, such as manufacturing occupations, construction occupations, etc.

PERFORMANCE: A clear statement of what the learner will be able to do after mastery status has been obtained.

PERFORMANCE OBJECTIVE: A statement, in measurable terms, of what behavior the learner will be able to exhibit under specified conditions. Each performance objective is composed of three parts: performance, conditions, and criterion or standard.

STANDARD: That part of a performance objective or of a criterion-referenced measure which describes how well or to what proficiency level a task must be performed. (Also called performance level, criterion, or work standard.)

STEP: The smallest aspect of a skill; a very specific level in the hierarchy of a job (i.e., Job-Duty-Task-Step); simpler abilities needed to do a more complex task.

TASK: A discrete unit of work performed by an individual in the completion of an assigned job duty (i.e., Job-Duty-Task-Step). (Also called skill, operation.) For example: a task that a cashier/checker might perform would be to bag customers' orders of merchandise.

TASK ANALYSIS: An organized method for determining the roles, responsibilities and jobs performed by workers in an occupation. Task analysis is used in CBE to establish instructional content and scope.

TASK LIST: A list of tasks performed by workers in an occupational domain. (Also called job inventory.)

Developing and Implementing CBE

The design, development and implementation of instructional materials, especially those for CBE courses, require a systematic approach. The guides, content, and formats have been prepared to provide the necessary occupational and related information needed to develop or revise a CBE course.

The following steps are suggested for CBE development and implementation:

1. Review the available information concerning the occupation in SECTION I. This will provide an overview of the occupation and program requirements. A comparison can be made between the present course being offered and what changes should be made to implement a competency based course.

2. The next step involves a review of the Task Analysis Sheets in SECTION II to determine if all tasks are included for the region or locality in which the program or course is offered.

3. The selection and sequencing of the instructional objectives can begin by reviewing the course content outlines in SECTION III and referring to the Task Analysis Sheets in SECTION II.

4. The construction of criterion-referenced test and measurement materials is next developed using the criterion-referenced measures provided on the Task Analysis Sheets in SECTION II.

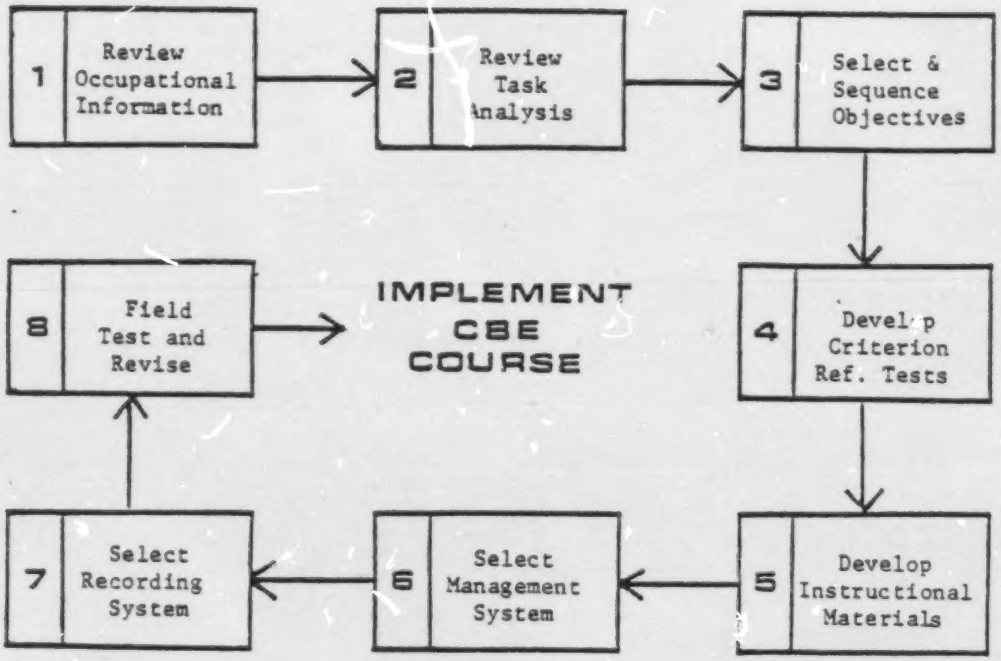
5. Once the objectives and criterion referenced measures have been identified and sequenced, instructional materials (student handouts, learning packages, modules and lab exercise or competency activity sheets) can be developed. Resources and materials for learning activities are included on the Task Analysis Sheets. Additional resources can be selected from the listing in SECTION VI of the guide.

6. After the instructional materials and tests have been identified or developed, a classroom management or delivery system can be selected from SECTION IV. Modification may be necessary to meet individual requirements.

7. A student recording system should be designed or selected from SECTION V. A decision to select a recording system will depend on program requirements and local administrative procedures. Various types of sample system designs have been included.

8. Finally, field testing of the instructional materials, management/delivery system, and recording system should be made before implementing the CBE materials.

The development and implementation of a competency based instructional course can be illustrated by the following diagram:



The above procedure which has been illustrated for development and implementation of CBE may be modified to meet local program requirements and needs. It is important that the materials in this guide be recognized as a resource and that additional materials may be necessary to meet the employment requirements of local industry.

OCCUPATIONAL INFORMATION

OCCUPATIONAL INFORMATION

The major goal of vocational and technical education in Virginia is to train the workers and technicians needed for our businesses and industries. It is important that we base our courses and programs on current and valid occupations in industry. The central theme of competency based vocational education is to base instruction on role-relevant tasks performed by incumbent workers. Therefore it is essential that vocational educators maintain a current knowledge of the specific occupation or job titles on which instruction is based.

This section will provide information concerning the specific occupation for which this instructional guide was developed. The information was obtained from the Occupational Outlook Handbook and Dictionary of Occupational Titles. The information in this section should be useful to the teacher in providing the following:

1. Specific career information for the student.
2. Occupational information for developing instructional materials and activities.
3. Specific career placement information for the parent and guidance counselor.
4. General information for vocational advisory committees and administrators.

WELDING OCCUPATIONS (DOT 810 through 819.887)

NATURE OF THE WORK

Welding is the most common way of permanently joining metal parts. Typically heat is applied to the metal pieces

to be joined, the parts melt, fuse, and then form a permanent bond. Because of its strength, welding is used to construct and repair parts of ships, automobiles, spacecraft, and thousands of other products. It also joins beams and steel reinforcing rods in buildings, bridges, and highways.

There are three common ways to create the heat that is applied to the parts being joined. In electric arc welding, the most frequently used process, heat is created in the arc as electric current flows through the arc between the tip of the welding electrode and the metal. In resistance welding, heat is created in the weld metal by resistance to the flow of current through the metal. In gas welding, the flame from the combustion of burning gases melts the metal. In arc and gas welding, filler materials, called welding electrodes or welding rods, are melted and added to the weld puddle to give the joint greater strength. It is the welder's job to control the amount of heat and the size of the melted area and to add the proper amount of filler material so that they form a strong joint.

Since welding processes differ and are used for many purposes, the equipment and skill levels of welders vary. Some jobs require highly skilled manual welders who know how to safely use gas and electric arc welding equipment in all positions and are able to plan their work from drawings or specifications. Other jobs can be handled by unskilled welding machine operators who simply press a button to start the welding machine. Skilled welders know the characteristics and properties, such as melting points, of steel, aluminum, and other commonly used metals. Examples of skilled welders are maintenance welders, pipe welders, and welders who construct ships and bridges.

In ship construction, welders join the steel plates, beams, and pipes. Some joints to be welded are on the floor, some are on the walls, and some are overhead. Each must be carefully welded to insure that the ship will not break apart in rough seas.

Ship welders generally use manual arc welding equipment, although semiautomatic equipment is used in some places. After welders read instructions to learn which materials and welding method to use, they obtain supplies from the storage area. To form a joint by arc welding, they use an electrode in a holder attached to an electrical cable coming from a welding power supply. Another such cable is attached to the metal being welded. Thus, electricity will flow through the welding electrode, through

the arc to the metal being welded, and back to the power supply. The power supply can be adjusted to provide the correct amount of current. When the power is turned on, welders "strike an arc" by briefly touching the electrode to the metal to start the electricity flowing and then pulling the rod back to form a small arc gap over which the current must flow. If the distance between the electrode and the metal is correct, a stable electric arc will bridge the space; the heat from the arc melts the electrode and the metal. Welders move the arc along the length of the joint. As the electrode melts and becomes shorter, they move the holder closer to the metal to keep the right distance from the arc. They replace very short electrodes.

Maintenance welders repair tools, machines, and equipment. Often they bring portable gas torches, hoses, and tanks to the job because electricity may not be available.

When working on a broken pipe, for example, they examine the pipe and prepare the break for repair. Maintenance welders then select a welding filler rod appropriate for the job. Next, they light the torch and adjust regulators on the cylinders of fuel gas, such as acetylene, and oxygen to obtain the right gas mixtures and flame. Then they heat the edges of the break with the torch. As the metal begins to soften, welders melt the end of the filler rod in the hot liquid metal as they carefully move the torch and rod along the break. Welders must keep the torch the correct distance from the metal, apply heat correctly, and repair the break with filler material.

Not all welders have the skills required of shipbuilding or maintenance welders. For example, less skilled workers use semiautomatic arc weld equipment to weld automobile frames. Semiautomatic equipment automatically supplies the proper amount of arc heat and filler material to the joint. For example, assembly lines bring car frames to welders who then position their welding guns near the parts to be welded and operate a switch on the handle which automatically starts the arc. They guide the arc to complete the required joints before the assembly line takes the frame to another worker. Like other welders, they are responsible for the quality of the joint. However, the job usually requires less manipulative skill because all parts are identical and each is welded in the same position.

Large factories, having many identical parts to be welded may reduce production costs by using automatic arc,

electron beam, or resistance welding machines. Workers who operate such machines to weld automobile mufflers and washing machines, for example, need little knowledge of welding. These workers, frequently called welding machine operators to distinguish them from more skilled, manual welders, place the parts to be joined in fixtures on the machine and push a button. The machine then clamps the part in place and positions it, as necessary, to complete the welding cycle. After the cycle is finished, operators remove the welded parts and load the machine again.

The work of arc and flame cutters is closely related to that of welders. Using heat from burning gases or an electric arc, cutters cut and trim rather than join metal. Some electrically and mechanically operated machines follow guidelines automatically.

WORKING CONDITIONS

Welders are exposed to more potential hazards than most other workers. They use protective clothing, safety shoes, goggles, helmets with protective lenses, and other devices to prevent burns and eye injuries. Although lighting and ventilation usually are adequate, some metals give off toxic gases and fumes as they melt. Workers often are in contact with rust, grease, and dirt on metal surfaces. Machine operators, however, are largely free from hazards associated with manual welding. A face shield or goggles generally are adequate protection. Skilled welders, working in welding booths, often have long periods of isolation from other workers.

PLACES OF EMPLOYMENT

In 1978, about 679,000 welders and flame cutters were employed, including a relatively small number of cutters who used both flame and arc-cutting equipment. Almost two-thirds of all welders help manufacture durable goods; for example, boilers, bulldozers, trucks, ships, and heavy machinery. Most of the rest repair metal products or help construct bridges, large buildings, and pipelines.

Welders are concentrated in the manufacturing centers of the Great Lakes States. About one-third work in Pennsylvania, Ohio, Michigan, Indiana, and Illinois. The rest are distributed much the same as the population, with large numbers in New York, Texas, Wisconsin, and California.

TRAINING, OTHER QUALIFICATIONS, AND ADVANCEMENT

Though several years of on-the-job training are required to become a skilled welder, less skilled work can be learned on the job in a few months. Some welding operators, for example, can operate a machine in a few hours and handle all parts of their job in a week.

Beginners often start in simple production jobs where the type and thickness of the metal and the position of the welding operation rarely change. As the need arises, supervisors or experienced workers teach new employees how to weld vertical and overhead joints and different metals. Many large companies train their own welders. A few companies have apprenticeship programs including classroom and on-the-job training that last several years.

Persons planning careers as welders or cutters need manual dexterity, good eyesight, and good eye-hand coordination. They should have the ability to concentrate on detailed work for long periods, and be physically able to bend, stoop, and work in awkward positions. Most employers prefer applicants who have high school or vocational school training in welding. Courses in shop mathematics, mechanical drawing, blueprint reading, physics, and chemistry also are helpful.

New technological developments, especially in the nuclear energy and aerospace, require new skills. Because of the hazards of nuclear power plant operation or high-speed air and space travel, both industries demand high standards of reliability for welds. Before being assigned to work on buildings, bridges, pipelines, or other jobs where the strength of the weld is highly critical, welders may be required to pass an examination of their welding skills given by an employer or government agency. Welders who pass such examinations generally are referred to as "certified welders."

Promotion opportunities for welders are good. Some welding machine operators learn skilled welding jobs; skilled welders may be promoted to welding inspectors, technicians, or supervisors. Experienced workers who have obtained college training are in great demand as welding engineers to develop new applications for welding. A small number of experienced welders open their own repair shops.

EMPLOYMENT OUTLOOK

Employment for welders is expected to increase faster than the average for all occupations through the 1980's because of the greater use of welding. In addition, many jobs should arise each year as welders retire, die, or transfer to other occupations. Job opportunities may vary as the economy fluctuates.

Increases in population and income are expected to stimulate demand for cars, buildings, heavy machinery, applicances, and thousands of other products that welders help make. Employment of welders also is expected to increase as welding replaces other methods of joining metals. Welding generally is cheaper than other methods of joining metal parts, and it is being used more frequently in the manufacturing and construction industries.

EARNINGS

National wage data on welders are not available. However, the limited data available indicate that welding machine operators earned from $6 to $7 an hour in 1978. Welders in the construction industry earned $9 to $12 an hour, depending on location.

Welders belong to many different unions. Among these are the International Association of Machinists and Aerospace Workers; the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; and the United Electrical, Radio and Machine Workers of America (Ind.).

RELATED OCCUPATIONS

Welders are highly skilled workers who must be very familiar with the properties of metal and use hand-held equipment or machines to do factory or construction work. Other people with similar duties are blacksmiths, forge shop workers, all-round machinists, instrument makers (mechanical), machine tool operators, and tool-and-die makers.

TASK ANALYSIS

TASK ANALYSIS

One of the major characteristics of competency based education (CBE) is the course content is based upon actual jobs or tasks performed by the worker. In Virginia, the Department of Education has established standards for competency based education. According to these standards, competencies must be "role-relevant" and based upon "appropriate research." This standard states:

> Role-relevant competencies that include standards are identified and stated.
>
> The competencies with standards will be identified through V-TECS, IDECC, and other appropriate research. Advisory Committees should be used to review competencies and standards. Competencies in the affective domain will be included. Role-relevant competencies for occupational preparation programs are those that specifically relate to the occupation for which the student is being prepared as well as to the personal needs of the student. Role-relevant competencies are related also to orientation, exploration and/or industrial arts experiences which have been identified for students.

Therefore "role-relevant" jobs or tasks, called competencies in CBE, must be identified and validated before instructional materials are developed and subsequent instruction can take place.

The task list contained in this instructional guide was based on the following:

1. The current V-TECS catalog for Combination Welder.
2. Job titles and descriptions found in the Occupational Outlook Handbook and Dictionary of Occupational Titles.

3. The review and selection of appropriate competency based materials developed by other states and systems.

4. Interviews with former students and incumbent workers in the field of welding and manufacturing.

5. Input from welding teachers and curriculum specialists.

6. Input from local craft advisory committee members.

Based upon the information collected and reviewed from the available sources indicated, a task inventory was prepared.

The next major step involved in the development of the task inventory was validation of the listed tasks. Validation is essential if the information collected is to be useful in operating CBE courses and programs. The validation process involved the following:

1. Review by writing team members to determine completeness of the inventory.

2. Review and validation by local craft advisory committee to insure the role-relevance and completeness of the inventory.

3. Review by selected incumbent workers in local and regional industry to determine validity of the inventory.

4. Final review and editing by writing team members, project directors and state staff.

This process was used to determine (1) if the identified tasks were performed by workers presently employed, (2) the time spent doing the specific task and (3) if the task was critical for job entry level.

The task list included in this instructional guide was based on current available resources and validated by

teachers, advisory committee members and incumbent workers in welding occupations. Regional and local tasks were included in the inventory; therefore, some tasks may not be applicable (or omitted) for your locality. It is essential that all instruction be based on the validated task analysis included in this instructional guide.

The task list has not been arranged in order of difficulty of tasks or instructional sequence because of the variety of courses and programs offered throughout the state. Sequencing has been shown in the sample course outlines for secondary and post-secondary welding courses in SECTION III of this guide.

The task analysis sheets are arranged by duty area for the specific occupational domain covered by the guide. Information contained on each form is as follows:

1. The task/competency for a given duty area which is performed by incumbent workers.
2. Program and course application information.
3. Performance and selected enabling objectives for instructional materials development.
4. Criterion-referenced measures or test items used to determine successful attainment of task/competency by the student.
5. Selected learning activities and steps required for teaching the task/competency.
6. Selected tools, materials and supplies required by the student to complete the task.
7. Selected audio-visual and reference materials helpful in teaching the task/competency.

TASK ANALYSIS

for

COMBINATION WELDER

DOT: 812.884-(014, 010, 018, 022, 038)

DUTY AREAS

1. Supervision, Training and Job Estimating
2. Set Up, Tack and Weld Metal Processing Projects. Select metals for fabrication from blueprint.
3. Clean, Test and Classify Metals.
4. Operating Gas Welding Equipment.
5. Operating Auxiliary Equipment and Tools.
6. Operating Metallic and Tungsten Inert Gas Welding Equipment (MIG, TIG).
7. Performing Structural or Equipment Welding and Cutting Operations.
8. Operating Shielded Metallic Arc Welding Equipment.

DUTY AREA 5

Operating Auxiliary Equipment and Tools

TASK/COMPETENCIES

5.1 Chip slag using chipping hammer

5.2 Cut material with hand hacksaws

5.3 Drill metal using power drilling equipment

5.4 Grind metal with power equipment

5.5 Cut metal with power hacksaw

5.6 Wire brush with power equipment

5.7 Finish metal surfaces with handtools

5.8 Shear and punch metal shapes using iron-working machine(s)

SELECTED INSTRUCTIONAL ACTIVITIES

1. Have student demonstrate the correct selection and use of safety goggles and shield. (E 5.1.1.)
2. Give a demonstration on the use of different types of chipping hammers. (E 5.1.2.)
3. Demonstrate the "side by side" method of chipping slag. (E 5.1.3.)
4. Have student practice chipping slag from welds. (p 5.1.)

TOOLS AND EQUIPMENT

1. Safety goggles or shield
2. Chipping hammer
3. Steel brush

   or

   See code #26, 27, 56 in Tool and Equipment List in Appendix.

SELECTED AUDIO VISUALS

Arc Welding Methods, Film, Macmillan Films, 1972

or

Basic Shielded Metal Arc Welding, Videotape #4, Cambridge, 1980.

SELECTED REFERENCES

Gianchino, J. W. Welding Skills and Practices. Chicago, IL: American Technical Society, 1971, page 63

PROGRAMS AND COURSES

PROGRAMS AND COURSES

The welding programs and courses described in this instructional guide are based on the task analysis presented in the previous section of the guide. All programs and courses listed have been approved by the Virginia Department of Education or the Virginia Community College System.

Approved courses for each secondary and post-secondary welding program are shown in the first part of this section. The courses are cross referenced to indicate applicable job titles and codes. The Dictionary of Occupation Titles, Vocational Education and Occupations, and Virginia Department of Education were consulted in determining occupational titles, DOT codes, and Virginia program and course codes.

The second part of this section contains course descriptions and content outlines. The course content and sequencing were developed by welding teachers utilizing the validated task analysis. The course outlines have been cross referenced, with the task analysis sheets to assist the instructor in identifying instructional objectives, materials, criterion standards and reference materials.

SECONDARY PROGRAMS AND COURSES

PROGRAM TITLE: Welding

DESCRIPTION: Specialized classroom and shop experiences concerned with all types of metal welding, brazing, and flame cutting. Instruction emphasizes properties of metals, blueprint reading, electrical principles, welding symbols, and mechanical drawing.

O. E. CODE: 17.2306 WELDING AND CUTTING

GRADE LEVEL: 10-12

APPROVED COURSE	VA COURSE CODE	DOT CODE/TITLE*
Welding I	8672	810.884-034 – Welder, Track
		812.884-010 – Welder, Apprentice, Combination
Welding II	8673	819.381-022 – Welder, Fitter
Welding III	8674	812.884-014 – Welder, Combination
		812.884-022 – Welder, Repair

PROGRAM OPTIONS: Option I: 8672, 8673

Option II: 8672, 8673, 8674

**Entry level competencies only*

WELDING I (8672)

COURSE DESCRIPTION: A triple period class in which instruction is provided in the technical knowledge and manipulative skills of welding. Instruction covers weld joints, electric welding, gas welding, metallurgy, resistance welding, and welding equipment.

PREREQUISITES: None

GRADE LEVEL: 10-11

TASK/COMPETENCY SEQUENCE

1.1	Demonstrate safety practices	4.8	Silver Solder
1.2	Demonstrate first aid	4.10	Select welding rods
3.2	Interpret blueprints/sketches	4.9	Prepare weld joints
1.5	Use safety equipment	6.2	Set up arc welding equipment
5.0	Select welding equipment/ tools	6.3	Adjust arc welders
5.8	Clean & adjust welding equipment	6.4	Run beads
5.3	Use hand tool/equipment	6.5	Arc weld carbon steel
4.1	Set up & use oxyacetylene equipment	6.8	Demonstrate welding positions
4.4	Gas weld carbon steels	5.5	Chip slag
4.5	Braze metals	5.7	Use power hacksaw
4.2	Tack Weld	6.10	Arc weld cast iron
		8.1	Demonstrate MIG/TIG welding
		10.2	Layout & fabricate projects

CONTENT OUTLINE	TASK/COMPETENCY CODE
I. Course Orientation	
II. Shop and Welding Safety	
A. Shop safety equipment	*all competencies*
1. fire extinguishers	
2. first aid equipment	

	3. alarm systems	
	4. shop evacuation plan	
	B. Shop safety rules	*all competencies*
	C. State laws and regulations	*all competencies*
	D. Welding safety	*all competencies*
	1. eye protection	
	2. burn protection	
	3. electrocution	
	4. explosions	
III.	Welding Metallurgy	P 2.6
	A. Introduction	
	B. Structure of metal-space lattices	E 2.6.1
	1. body-centered cube	
	2. face-centered cube	
	3. close packed hexagonal	

CLASSROOM MANAGEMENT SYSTEMS

CLASSROOM MANAGEMENT SYSTEMS

If students in our vocational courses and programs are to be provided with the instruction necessary for entry into an occupation, then a systematic method of instruction must be utilized. Competency based vocational education courses require an instructional system which may be different from those used in traditional instructional programs.

The purpose of this section is to illustrate several examples* of classroom management and instructional systems developed by teachers utilizing competency based vocational education techniques in their courses and programs. The systems have been field tested and revised for use in laboratories and classrooms in Virginia. Each example has been developed and written for student use, therefore the systems could be included in a student course guide.

*only one is shown in the sample

INSTRUCTIONAL SYSTEM "A"

The instructional materials in this course have been designed to assist you in learning the basic manipulative skills and technical knowledge of welding. Only competencies and skills needed by the welder are included in this course of study. Therefore, only relevant and necessary skills and knowledge will be covered in the instructional materials.

The instructional materials have been divided into short blocks or units covering one or two competencies. These units of information are called "Modules" which contain all information and direction in order to learn a required competency or skill. In each welding course there are usually eight to ten modules.

As a student, you have three learning options or choices in completing a particular module. The first, "Group Meeting Option," is basically the scheduled lecture-lab sequence in which you meet with other students on a weekly basis. Shown below are the learning sequence steps for this option. In order for you to learn the content or competencies of a particular module you must follow each step carefully. Refer to Figure 1 on the next page.

STEP 1 First, carefully read the directions, introduction, performance objectives and enabling objectives contained in the module. If after reading them you feel that you can successfully do what has been stated, see your instructor and ask to take the "Pre Assessment" test. If you score 90% or greater, you can then proceed to the next module; if not, proceed to Step 2.

STEP 2 This step consists of a number of learning activities such as reading assignments, information sheets and optional audio visual presentations. You will need this information in order to complete the "Response Sheet," "Project Sheet," and "Post Assessment" test in the module.

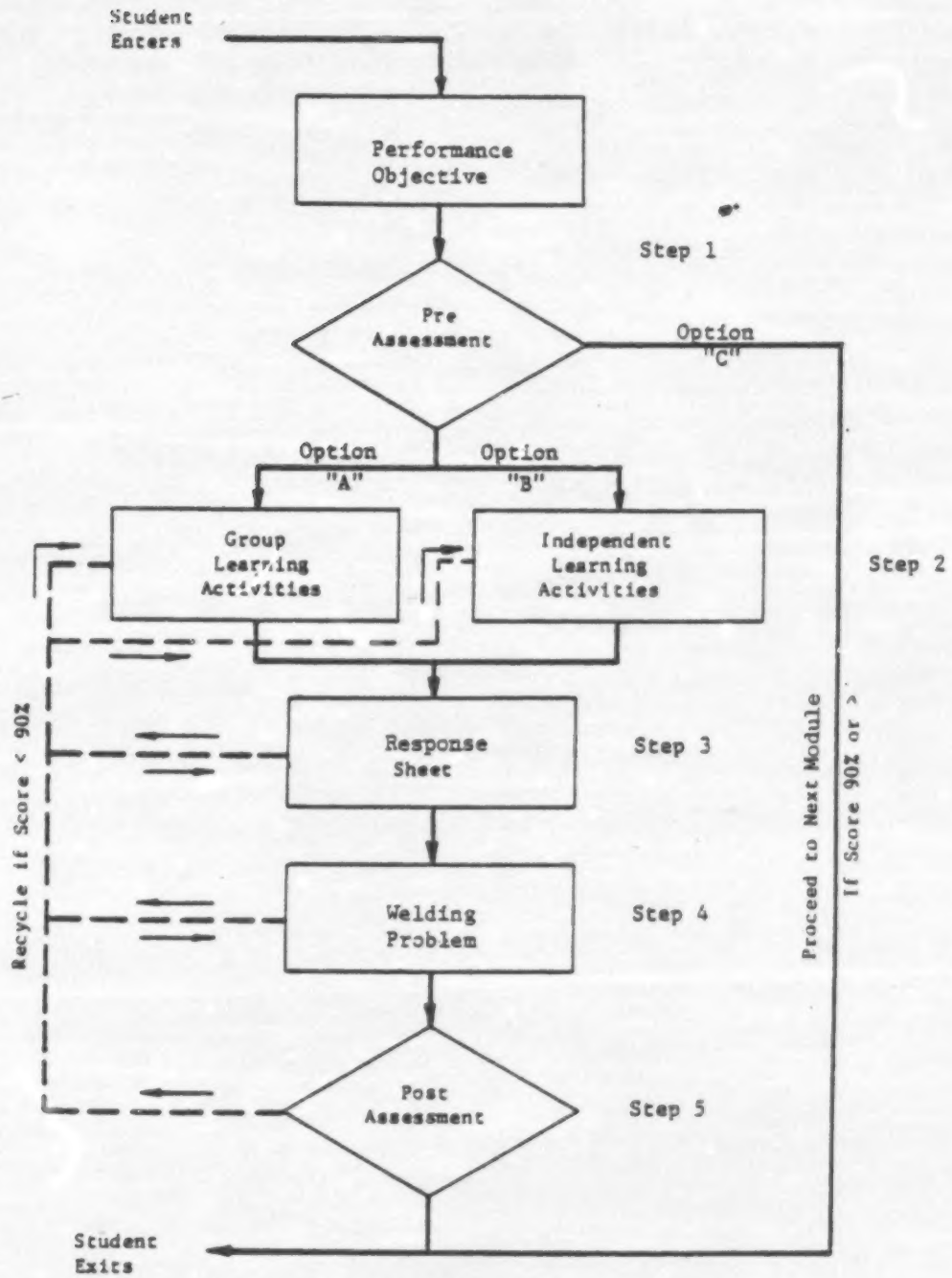
STEP 3 After completing steps 1 and 2 you are now ready to complete the "Response Sheet." The purpose of this activity is to assess your knowledge and skills stated in performance and enabling objectives. When you complete the "Response Sheet," have it scored by your instructor. You must score 90% or better to proceed to the next step; if not, review steps 1 and 2 until you can successfully complete the "Response Sheet."

STEP 4 Next, read the directions for the welding project and obtain the materials needed. Complete the "Project Sheet" and have it scored by your instructor. If you score less than 90%, review steps 2 and 3; if not, proceed to the next step.

STEP 5 The final activity required in order to complete the module is successful completion of the "Post Assessment" test. If you score 90% or greater, you may proceed to the next module; if not, you must review steps 2 - 4 until you can successfully pass this test with a score of 90%.

Figure 1

The Instructional System and Sequence
Used in the Modules



The second option you have is the "Independent Study Option" in which you may elect not to attend the regular scheduled class meeting and therefore study indendently the materials in the modules. With the exception of attending a discussion group meeting and working during regular class hours you complete the same learning sequence as outlined above.

Finally, there is available the "Post-test Option" that requires you to take a practical exam (welding problem) and post assessment test concerning the materials in the module. This option is provided for in step 1 of the learning sequence described above. Upon successful completion of the practical and written tests you may proceed to the next module.

A student may elect any of the three learning system options with the approval of his instructor. All options require the same proficiency level of 90% to satisfactorily complete a learning activity or module. You may also elect another instructional system option if you are unsuccessful in the option you choose.

If after reading this section on using modular materials, you have any questions, see your instructor.

STUDENT RECORDING SYSTEMS

STUDENT RECORDING SYSTEMS

Competency based vocational education in Virginia requires a system for documenting competencies which have been achieved by each student. This information is essential to the student, teacher, and employer. For the student, it provides a record of successful progress through the vocational program. If the student should transfer to another school or enter the community college system, the record will assist in a smooth transistion, eliminating the need to repeat skills and knowledge learned. Therefore the competency record facilitates articulation between vocational programs at different levels of instruction. The teacher utilizes the competency record for evaluation and planning purposes in the course. Perhaps the most important use of a competency recording system is that it provides specific job entry information to prospective employers.

This section therefore includes several examples of competency recording systems for courses and programs. The systems developed for this instructional guide were designed for use by the instructor, student records personnel, and for the student's personal record. An example of each type of system is provided in this section.

SYSTEM A

EMPLOYABILITY PROFILE

OSWEGO COUNTY BOARD OF COOPERATIVE EDUCATIONAL SERVICES
MEXICO, NEW YORK 13114
PHONE: 315-963-7251

1974 - 1975

Name _____ Home School _____ Grade ____

Course WELDING Date _____ Quarter 1st__ 2nd__ 3rd __ Final

The following is a list of operations and skills that the above student has been exposed to, and instructor's appraisal of his/her entry level employability in these areas. These operations have been accompanied by a significant amount of classroom work in related theory.

GAS WELDING MODULE I
- ☐ Oxy-Acetylene Orientation
- ☐ Lines of Fusion
- ☐ Forehand Beads with Filler Metal
- ☐ Open Corner Joint (Fusion)
- ☐ Square Groove Butt Joint
- ☐ Lap Joint
- ☐ Horizontal Fillet Weld
- ☐ Backhand Beads with Filler Metal
- ☐ Downhand Vee Groove Weld (Backhand)
- ☐ Horizontal Fillet Weld Pipe to Plate
- ☐ Horizontal Lap Weld
- ☐ Overhead Lap Weld
- ☐ Horizontal Butt Weld
- ☐ Vertical Up Butt Weld
- ☐ Vertical Up Lap Weld
- ☐ Roll Weld, Vee Groove, Pipe (Positioner)
- ☐ Vee Groove, Butt Weld (2G) Pipe
- ☐ Vee Groove, Butt Weld (5G) Pipe
- ☐ Operate Equipment Safely

GAS CUTTING MODULE II
- ☐ Manual Cutting Orientation
- ☐ Machine Cutting Orientation
- ☐ Manual Cut to Tolerance
- ☐ Machine Cut to Tolerance
- ☐ Manual Cut by Hole Piercing
- ☐ Machine Bevel Cut to Tolerance
- ☐ Machine Bevel But Pipe
- ☐ Machine Cut from Template to Tolerance

BRAZING MODULE III
- ☐ Brazing Orientation
- ☐ Running Beads with Bronze Rod
- ☐ Brazed Butt Weld
- ☐ Brazed Lap Weld
- ☐ Brazed Fillet Weld
- ☐ Brazed Beveled Butt Weld
- ☐ Brazed Pipe to Plate
- ☐ Brazed Horizontal Vee Groove Butt Weld
- ☐ Brazed Vertical Up Vee Groove Butt Weld
- ☐ Brazed Roll Weld - Pipe Positioner
- ☐ Brazed Weld (Cast Iron)
- ☐ Silver Soldering

ARC WELDING MODULE IV
- ☐ Arc Welding Orientation
- ☐ Downhand Stringer Bead
- ☐ Downhand Stringer Pad — E-6012, E-7014, E-7024, E-7018, E-6010
- ☐ Stringer Weave Pad
- ☐ Tacking Plates for Joints
- ☐ Horizontal Fillet Weld
- ☐ Downhand Corner Weld
- ☐ Downhand Vee Groove
- ☐ Downhand Pipe to Plate
- ☐ Downhand Square Groove
- ☐ Lap Weld - Sheet Metal — E-6011, E-6013
- ☐ Fillet Weld - Sheet Metal
- ☐ Horizontal Pad
- ☐ Horizontal Vee Groove
- ☐ Overhead Fillet Weld
- ☐ Overhead Pad
- ☐ Overhead Vee Groove — E-6010, E-7018
- ☐ Vertical Stringer Pad
- ☐ Vertical Weave Pad
- ☐ Vertical Fillet Weld
- ☐ Vertical Vee Groove
- ☐ Pipe Welding Orientation
- ☐ Stainless Steel Welding
- ☐ Nickel-Cast Iron Welding
- ☐ Hard Surfacing

MIG WELDING MODULE V
- ☐ Mig Welding Orientation
- ☐ Running Beads on Sheet Metal (Small Wire)
- ☐ Lap Joint, Sheet Metal
- ☐ Tee Joint, Sheet Metal
- ☐ Tee Joint, Sheet Metal
- ☐ Square Groove Butt Joint, Sheet Metal
- ☐ Vee Groove Butt Joint, Plate
- ☐ Horizontal Lap Joint
- ☐ Overhead Lap Joint
- ☐ Vertical Down Tee Joint
- ☐ Vertical Up, Tee Joint
- ☐ Operate - Mig Aluminum
- ☐ Operate Equipment Safely

TIG WELDING MODULE VI
- ☐ Tig Welding Orientation
- ☐ Running Beads Tig Aluminum
- ☐ Square Groove Butt Joint, Aluminum
- ☐ Lap Joint - Aluminum
- ☐ Running Beads, Tig Stainless
- ☐ Square Groove Butt Joint, Stainless
- ☐ Corner Joint, Fusion-Stainless
- ☐ Lap Joint - Stainless
- ☐ Tee Joint - Stainless
- ☐ Tig Welding Mild Steel
- ☐ Tig Welding Out of Position
- ☐ Operate Equipment Safely

FABRICATION MODULE VII
- ☐ Hand Tool Orientation and Safety
- ☐ Bench Work
- ☐ Shear Orientation and Safety
- ☐ Saw Orientation and Safety
- ☐ Grinder Orientation and Safety
- ☐ Brake Orientation and Safety
- ☐ Clamping, Jigs and Fixtures
- ☐ Layout, Set-Up and Tacking
- ☐ Distortion - Control
- ☐ Arc - Air Cutting

					Total Days Absent			Excused		Unexcused

TEACHER'S COMMENTS _____

SYSTEM B

TRAINING ACHIEVEMENT RECORD

Name_____ SSN_____ Date Trainee Entered Training_____

Title WELDER 2 DOT Code 812.884 Certified by_____ Form No. 440.102 A

Achieved Individual Marketable Skill		PERFORMANCE				KNOWLEDGE			
		1	2	3	4	a	b	c	d
Shop or Job Safety Practices									
1. Demonstrate first aid procedures for burns	4d								
2. Demonstrate correct safety procedures for handling oxygen/acetylene equipment	4d								
3. Practice correct eye protection procedures for gas,arc,TIG,MIG,etc.	4d								
4. Demonstrate correct safety procedures for handling electrical equipment	4d								
5. Demonstrate correct safety procedures for grinding & chipping	4d								
6. Practice correct fire prevention procedures	4d								
General									
7. Interpret blueprints for material layout	2b								
8. Read & use blueprints, sketches,diagrams for dimensions,specs,tolerances,etc.	2b								
9. Make destructive tests on welds performed	2b								
10. Describe different non-destructive tests & their applications	1a								
11. Identify metals for welding tasks	2b								
12. Examine workpieces; measure dimensions for conformance to spec	3b								
13. Perform tasks of flame cutting & grinding	3c								
14. Repair broken & cracked parts	2b								
15. Position & clamp components & fabricated parts for welding tasks	2b								
16. Clean grease or corrosion from workpiece prior to welding tasks	4d								
17. Chip & grind out holes, bubbles or cracks to prepare for filling	4d								
18. Use common hand tools for disassembly/assembly of parts	3c								
19. Use chemical to prepare metals for welding tasks	2b								
Oxyacetylene Welding & Cutting									
20. Set up, prepare & use oxyacetylene equipment & safety devices	3c								
21. Accomplish Flat,Butt,Tee,Corner & Lap Welds	3c								
22. Weld in horizontal & vertical positions	3c								
23. Perform tasks of brazing & bronze welding	2b								
24. Select proper welding equipment, cuts, thicknesses of metals	3c								
Arc Welding									
25. Set up, prepare & use arch welding equipment & safety devices	3c								
26. Adjust welding units to desired current	2b								
27. Select electrodes for tasks, based on bead, type, thickness of metal	2b								
28. Connect welding units to obtain desired polarity	2b								
29. Accomplish Flat, Butt, Tee, Corner & Lap Welds	3c								
30. Weld in horizontal, vertical & overhead positions	3c								
31. Examine weld for size of bead & penetration	3c								
Tungsten Inert Gas Welding									
32. Set up, prepare & use TIG welding equipment	2b								
33. Set up & adjust apparatus for wounding various metals	2b								
34. Select & identify appropriate type of filler rod	2b								
35. Perform welds on various metals	2b								
36. Adjust electrode gap, gas flow rate & electric current	2b								

INFORMATION AND RESOURCES

INFORMATION AND RESOURCES

The collection and utilization of instructional resources such as reference books, films, slides, transparencies and periodicals are valuable sources of information for the teacher and curriculum developer. These materials are useful in developing instructional materials and providing instruction activities.

This section includes a listing of reference books, periodicals and audio-visual materials which have been identified by teachers as useful in developing competency based instructional course material.

BOOKS

The Pipefitter's and Pipe Welder's Handbook. Hobart Brothers, 175 pp., $6.20.

This is a pocket size booklet containing layout information for making different types of pipe joints.

Pipefitter's Handbook. Hobart Brothers, 410 pp., $15.40.

This is a working notebook which includes tables for pipe bends, offsets, mitered joints, pipe and fitting dimensions, and miscellaneous information useful in the field and pipe welding shop.

Pipefitter Welder's Review of Metal-Arc Welding for Qualification Under ASME Code Rules. Hobart Brothers, 34 pp., 75¢.

This guide is a review of metal-arc welding which can be used in preparation for ASME or state qualification tests.

Pipefitter Welder's Review of Oxyacetylene Welding for Qualification under ASME Code Rules. Hobart Brothers, 40 pp., 75¢.

This guide is a review of oxyacetylene welding defects and remedies which can be used in preparation of ASME or state pipe welding qualification tests.

Planning and Equipping School Shops for Trade and Industrial Education. Research and Curriculum Unit, Mississippi State University, 1969, 112 pp., $3.50.

This publication contains detailed floor plans for most vocational shops, including welding.

Pocket Welding Guide. Hobart Brothers, 144 pp., 50¢.

This is a condensed arc welding course in a paperback-size manual.

Porta-slag Welding Manual. Hobart Brothers, 127 pp., $3.00.

This is a book on the electro-slag welding process, its equipment, welding procedures, and applications.

Practical Problems in Mathematics for Welders by F. R. Schell and B. J. Matlock. Delmar Publishers, 1975, $3.90; Instructor's Guide, $1.25.

PERIODICALS AND JOURNALS

Abrasive Methods. Monthly. American Society for Abrasive Methods, 1049 South Main Street, Plymouth, Michigan 48170. Complimentary to Members.

American Vocational Journal. Monthly. American Vocational Association, 1510 H Street, N.W., Washington, DC 20005. $8.00 a year.

Canadian Welder and Fabricator. Monthly. Sanford Evans Publishing Ltd., 1077 Saint James Street, P.O. Box 6900, Winnipeg, Manitoba, Canada R3C 3B1. $10.00 a year.

Finisher's Management. Monthly. National Association of Metal Finishers, 22 South Park Street, Montclair, New Jersey 07042. $10.00 a year.

Finishing Highlights. 6/year. Special Technical Publications, P.O. Box 2035, Oxnard, California 93034. $7.50 a year (members), $15.00 (non-members).

Grinding and Finishing. Monthly. Hitchcock Publishing Co., Hitchcock Building, Wheaton, Illinois 60187. $6.00 a year.

Grits and Grinds. Monthly. Norton Co., 3 New Bond Street, Worchester, Massachusetts 01606. Complimentary.

Hobart Weldworld. Quarterly. Hobart Brothers Co., 500 West Main Street, Troy, Ohio 45373. Complimentary.

Industrial Design. 10/year. Whitney Publications, 18 East 50th Street, New York, New York 10022. $20.00 a year.

FILMS

ABC of Hand Tools. 33 min., color, General Motors, 1946, complimentary loan.

> This film was produced by Walt Disney and teaches the use and care of hand tools. The film is in two parts, each complete in itself. Part I covers the handling of the hammer, screwdrivers, pliers, and wrenches. Part II covers files, saws, chisels, planes, and punches. Both parts may be booked together or each one separately.

AC Flat and Horizontal Welding. 11 min., color, General Electric, 1950, available from Pennsylvania State University, Audio-Visual Services, $4.40 (rental).

> This film explains how to use larger electrodes and get higher speeds when welding.

Advantages of AC Welding. 19 min., color, University of Idaho, Audio-Visual Center, 1950, $1.50 (rental).

> Describes how AC welding equipment joins mild steel, cast iron, stainless steel, and all kinds of alloy steel. The film also shows AC welding's advantages over gas welding.

Aluminum Film Catalog. Aluminum association, 14 pp., complimentary.

This catalog is an annotated listing of motion pictures and filmstrips about the manufacturing and use of aluminum. The films are available from different sources on a free loan or rental basis.

Aluminum Welding. 30 min., b&w, Reynolds, 1958, complimentary loan.

Explains the fundamentals of welding, brazing, and soldering aluminum and its alloys.

Arc Welding Electrode Selection. 20 min., color, Hobart Brothers, 1960, $150.00 or complimentary loan.

This film demonstrates factors to be considered in selecting proper electrodes.

Arc Welding Methods. 28 min., color, Macmillan Films, 1972, $25.00 (rental), $225.00 (purchase); also available from

FILMSTRIPS, FILMLOOPS, AND SLIDES

AC and DC Shielded Metallic Welding Explained. Sound filmstrip, color, Bergwall Production, write for price.

This filmstrip explains the characteristics of AC and DC arc welding, as well as procedures for setting up and using the equipment, preparing the metal, welding positions, and oxy-arc cutting.

Advanced Arc Welding Course. 8 filmstrips with audio cassettes, color, Westinghouse Learning Corp., $280.00.

This individualized course in advanced arc welding concentrates on sophisticated welding techniques. Emphasis is on practical experience and covers such welds as: the vertical lap joint; the vertical T joint (stringer beads, coverpasses, and weaves); the vertical V-grooved butt joint; the overhead T-joint; the overhead V-grooved butt joint; horizontal pipe; and all-position pipe. A film version is available at a cost of $425.00.

Aircraft Welding. Filmstrip with audio cassette ($26.00) or record ($24.00), color, 1974, Media Fair.

Several aircraft welding techniques for both electric arc and oxyacetylene methods are explained and illustrated in this filmstrip. Many of these techniques are peculiar only to the aircraft and aerospace industry. Tube welding, seam welding, and several other specialized wire feed methods are demonstrated.

Arc Welding. 12 filmloops with audio cassettes, DCA Educational Products, $25.50 each.

This series covers basic arc welding techniques. Information is given on tools and welding symbols. The series is also available as a 16mm film which can be purchased for $225.00.

TRANSPARENCIES

Arc and Oxy Welding. 28 transparency masters, Iowa Association of Vocational Instructional Materials, Iowa State University, $1.50.

This set of transparency masters covers: welding fundamentals; welding nomenclature; weld profiles; welder specifications; electrode selection; welding positions; flame types; and gases.

Arc Welding. 53 transparencies with 25 overlays, DCA Educational Products, $142.50 for the series.

This series illustrates basic arc welding techniques, tools, and welding symbols.

Gas Tungsten Arc and Gas Metal Arc. 80 transparencies, Instructional Materials Laboratory, University of Missouri-Columbia, $32.00.

This set of transparencies covers the content in the book Gas Tungsten Arc and Gas Metal Arc published by the University of Missouri-Columbia.

Resistance and Special Welding Processes. 25 transparencies, University of Missouri-Columbia, Instructional Materials Laboratory, $10.00.

This set of transparencies covers the content in the book Resistance and Special Welding Processes published by University of Missouri-Columbia.

OTHER MEDIA

Cut-a-Way Charts. Wall charts, Victor Equipment, complimentary.

> This set of seven 17" X 22" wall charts illustrates apparatus component parts, separation of gases and gas flow, and principal design features.

Cutting Chart. Wall chart, Victor Equipment, complimentary.

TRADE AND PROFESSIONAL ORGANIZATIONS

American Boiler Manufacturer Association
Suite 317
AM Building
1500 Wilson Boulevard
Arlington, Virginia 22209

American Gas Association
1515 Wilson Boulevard
Arlington, Virginia 22209

American National Metric Council
1625 Massachusetts Avenue, N.W.
Washington, D.C. 20036

American National Standards Institute
1430 Broadway
New York, New York 10018

American Society for Testing and Materials
1917 Race Street
Philadelphia, PA 19103

American Welding Society
Education Operations
2501 N.W. 7th Street
Miami, Floria 33125

Center for Metric Education
Western Michigan University
Kalamazoo, Michigan 49001

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APPENDIX

TOOL AND EQUIPMENT LIST

The following tools and equipment have been listed for instructional planning and facility development. The list includes all tools and necessary equipment for teaching the competencies contained in this guide. The equipment code number is included on the appropriate task analysis sheet in SECTION II.

CODE NUMBER	DESCRIPTION
1	Anvil
2	Apron Welding
3	Angle Dividers
4	Air Compressor
5	Band Saw Blade Welder
6	Box and Pan Break
7	Brush, Bench
8	Brush, Wire
..	...
110	Welder, Arc A C
111	Welder, Flux-Cored
112	Welder, MIG
113	Welder, Spot
114	Welder, Submerged ARC
115	Welder, TIG
116	Welder, Oxyacetylene
117	Welder, MAPP Gas
118	Wrench, Impact
119	Wrench, Adjustable End
120	Wrench, Allen Key Hex Set
121	Wrench Box Set
122	Wrench, Open End Set
123	Wrench, Pipe
124	Wrench, Socket 3/8 inch drive set
125	Wrench, Socket 1/2 inch drive set
126	Wrench, Gas Torch

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The activity which is the subject of this report was supported in whole or in part by the U. S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the U. S. Office of Education, and no official endorsement by the U. S. Office of Education should be inferred.